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V. *A Letter from Mons. Du Fay, F. R. S. and of the Royal Academy of Sciences at Paris, to his Grace CHARLES Duke of Richmond and Lenox, concerning Electricity. Translated from the French by T. S. M D.*

Paris, December 27, 1733.

My L O R D,

I Flatter my self your Grace will not be displeased with an Account of some extraordinary Discoveries I have made in the *Electricity* of Bodies, nor refuse the Favour I have to ask, that it may be communicated to the *Royal Society*. I owe this Homage to that Illustrious Body, not only as a Member thereof, but in this respect as a Debtor to their Works; for the Writings of Mr. *Gray*, and the late Mr. *Hauksbee*, both of that *Society*, first put me upon the Subject, and furnish'd me with the Hints that led me to the following Discoveries.

First, I have found that all Bodies (metallick, soft or fluid ones excepted) may be made Electric, by first heating them more or less, and then rubbing them on any sort of Cloth. So that all kinds of Stones, as well precious as common, all sorts of Wood, and in general every thing that I have made Trial of, became Electric, by heating and rubbing; except such Bodies as grow soft by Heat, as the Gums, which dissolve in Water, Glue, and such other Substances. 'Tis also to be remark'd, that the
hardest

hardest Stones and Marbles require more chafing or heating than others, and that the same Rule obtains with regard to the Woods; so that Box, *Lignum Vitæ*, and such others must be chafed almost to the Degree of burning, whereas *Fir*, *Lime-Tree* and *Cork*, require but a moderate Heat.

Secondly, Having read in one of Mr. Gray's Letters, that Water may be made Electrical by holding the excited Glass Tube near it (a Dish of Water being first fix'd to a Stand, and that set on a Plate of Glass, or on the Brim of a Drinking-Glass, previously chafed, or otherwise warmed) I have found upon Trial, that the same thing happen'd to all Bodies without Exception, whether solid or fluid; and that for that Purpose 'twas sufficient to set them on a Glass-Stand slightly warm'd, or only dried; and then by bringing the Tube near them, they immediately became Electrical. I made this Experiment with Ice, with a lighted Wood-coal, and with every thing that came into my Mind; and I constantly remark'd, that such Bodies as of themselves were least Electrical, had the greatest Degree of Electricity communicated to them at the Approach of the Glass Tube.

Thirdly, Mr. Gray says, towards the End of one of his Letters, that Bodies attract more or less according to their Colours. This led me to make several very singular Experiments. I took nine silk Ribbons of equal Size, one white, one black, and the other seven of the seven primitive Colours, and having hung them all in Order on the same Line, and then bringing the Tube near them, the black one was first attracted, the white one

Philos. Transf.
N^o 422. p. 227.

Philos. Transact.
N^o 417 p. 44.

one next, and the others in Order successively to the red one, which was attracted least, and the last of them all. I afterwards cut out nine square Pieces of Gauze, of the same Colours with the Ribbons, and having put them one after another on a Hoop of Wood with Leaf-Gold under them, the Leaf-Gold was attracted thro' all the coloured Pieces of Gauze, but not thro' the white or black. This inclined me at first to think, that the Colours contributed much to Electricity. But three Experiments convinced me of the contrary: The first, that by warming the Pieces of Gauze, neither the black nor white Pieces obstructed the Action of the Electrical Tube more than those of the other Colours. In like manner, the Ribbons being warm'd, the black and white are not more strongly attracted than the rest. The second is, the Gauzes and Ribbons being wetted, the Ribbons are all attracted equally, and all the Pieces of Gauze equally intercept the Action of Electrick Bodies. The third is, that the Colours of a Prism being thrown on a Piece of white Gauze, there appear no Differences of Attraction. Whence it follows, that this Difference proceeds not from the Colour, as a Colour, but from the Substances that are employ'd in the dying. For when I coloured Ribbons, by rubbing them with Charcoal, Carmine, and such other Substances, the Differences no longer proved the same.

Fourthly, Having communicated the Electricity of the Tube by means of a Packthread, after Mr. Gray's manner, I observ'd, that the Experiment succeeded the better for wetting the Line; and that it may be supported on Glass-Tubes instead of Silk-Lines. And I made this Experiment at 1256 Feet Distance,

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in a Garden, tho' the Wind was high, and that the Line made eight Returns, and pass'd thro' two different Walks. By means of two Silk Loops I adjusted two Lines in such a manner, that their Ends were but a Foot distance from one another, and I remark'd that the Electrick Virtue was still communicated. I have since that seen in the *Philos. Transf.* N° 426, p. 431, that Mr. Gray had the same Thought, and that he had done the same with Rods. This Experiment put me upon placing several different Bodies between the two Lines, in order to examine which diminished or intercepted the Electricity, and which gave no Obstruction to it ; I have given the *Academy* an Account of the Particulars, which I now omit for the sake of Brevity.

Fifthly, I suspended a Child on Silk Lines, and made all the surprising Experiments described by Mr. Gray. But having tried the Experiment upon my own Body in the same manner, I observed several things very remarkable. First, when I take the Paste-board or Stand, on which the Leaf-Gold is laid, into my Hand, neither my other Hand nor my Face has any Attraction. But if another Person, who is in the Chamber, come near me, he will attract it with his Face, his Hand, or even with a Stick. Secondly, while I am suspended on the Lines, if the electrick Tube be put near one of my Hands, or my Legs, and then if another Person approach me, and pass his Hand within an Inch or thereabouts of my Face, Legs, Hand or Cloaths, there immediately issues from my Body one or more pricking Shoots, with a crackling Noise, that causes to that Person as well as to my self, a little Pain

Pain resembling that from the sudden Prick of a Pin, or the burning from a Spark of Fire, which is as sensibly felt thro' ones Cloaths, as on the (bare) Hand or Face. And in the Dark these Snappings are, as may be easily imagined, so many Sparks of Fire. These Snappings, or Sparks, are not excited, if a Bit of Wood, Cloth, or any other Substance than a living Body be passed over the Person suspended on the Lines, unless it be a Piece of Metal, which produces very nearly the same Effect. Any other living Animal doth the same, if put on the Lines, and that first the Tube, and then the Hand be applied near it: But it is otherwise, if the Experiment be made with the Carcass of an Animal; for then one perceives only, if it be in the Dark, a still uniform Light, without Snappings or Sparks. I omit many other Circumstances of less Importance, though curious, to avoid running into too great a Length.

Sixthly, On making the Experiment related by *Otho de Guerik*, in his Collection of Experiments *de Spatio Vacuo*, which consists in making a Ball of Sulphur render'd Electrical, to repel a Down-Feather, I perceived that the same Effects were produced not only by the Tube, but by all electrick Bodies whatsoever; and I discovered a very simple Principle, which accounts for a great Part of the Irregularities, and if I may use the Term, of the Caprices that seem to accompany most of the Experiments on Electricity. This Principle is, that Electrick Bodies attract all those that are not so, and repel them as soon as they are become electrick, by the Vicinity or Contact of the electrick Body. Thus
Leaf-

Leaf-Gold is first attracted by the Tube ; and acquires an Electricity by approaching it ; and of consequence is immediately repell'd by it. Nor is it re-attracted, while it retains its electrick Quality. But if, while it is thus sustain'd in the Air, it chance to light on some other Body, it straightways loses its Electricity ; and consequently is re-attracted by the Tube, which, after having given it a new Electricity, repels it a second time ; which continues as long as the Tube keeps its Electricity. Upon applying this Principle to the various Experiments of Electricity, one will be surprized at the Number of obscure and puzzling Facts it clears up. For Mr. *Hauksbee's* famous Experiment of the Glass Globe, in which Silk Threads are put, is a necessary Consequence of it. When these Threads are ranged in Form of Rays by the Electricity of the Sides of the Globe, if the Finger be put near the Outside of the Globe, the Silk Threads within fly from it, as is well known ; which happens only because the Finger, or any other Body applied near the Glass Globe, is thereby render'd electrical, and consequently repels the Silk Threads, which are endow'd with the like Quality. With a little Reflection one may in the same manner account for most of the other *Phænomena*, and which seem inexplicable, without attending to this Principle.

Seventhly, Chance has thrown in my way another Principle, more universal and remarkable than the preceding one, and which casts a new Light on the Subject of Electricity. This Principle is, that there are two distinct Electricsities, very different from one another ; one of which I call *vitreous*
M m *Electri,*

Electricity, and the other *resinous Electricity*. The first is that of Glass, Rock-Crystal, Precious Stones, Hair of Animals, Wool, and many other Bodies: The second is that of Amber, Copal, Gum-Lack, Silk, Thread, Paper, and a vast Number of other Substances. The Characteristick of these two Electricities is, that a Body of the *vitreous Electricity*, for Example, repels all such as are of the same Electricity; and on the contrary, attracts all those of the *resinous Electricity*; so that the Tube, made electrical, will repel Glass, Crystal, Hair of Animals, &c. when render'd electrical and will attract Silk, Thread, Paper, &c. though render'd electrical likewise. Amber on the contrary will attract electrical Glass, and other Substances of the same Class, and will repel Gum-Lac, Copal, Silk, Thread, &c. Two Silk Ribbons rendered electrical, will repel each other; two Woollen Threads will do the like; but a Woollen Thread and a Silk Thread will mutually attract one another. This Principle very naturally explains, why the Ends of Threads, of Silk, or Wool, recede from one another in Form of a Pencil or Broom, when they have acquired an electrical Quality. From this Principle one may with the same Ease deduce the Explanation of a great Number of other *Phænomena*. And 'tis probable, that this Truth will lead us to the further Discovery of many other things.

In order to know immediately, to which of the two Classes of Electricity belongs any Body whatsoever, one need only render Electrical a Silk Thread, which is known to be of the *resinous Electricity*, and see whether that Body, render'd electrical, attracts

attracts or repels it. If it attracts, 'tis certainly of that kind of Electricity which I call *vitreous*; if on the contrary it repels, 'tis of the same kind of Electricity with the Silk, that is, of the *resinous*. I have likewise observed that communicated Electricity retains the same Properties: For if a Ball of Ivory, or Wood, be set on a Glass Stand, and this Ball be render'd electrick by the Tube, it will repel all such Substances as the Tube repels; but if it be rendered electrick by applying a Cylinder of Gum-Lac near it, it will produce quite contrary Effects, *viz.* precisely the same as Gum-Lac would produce. In order to succeed in these Experiments, 'tis requisite that the two Bodies, which are put near one another, to find out the Nature of their Electricity, be rendered as electrical as possible; for if one of them was not at all, or but weakly electrical, it would be attracted by the other, though it be of that Sort, that should naturally be repelled by it. But the Experiment will always succeed perfectly well, if both the Bodies are sufficiently electrical.

I have several other Methods to discover the Nature of the Electricity any Body is of; but my Letter is already long enough, and my Design was only to give your Grace a very succinct Extract of the Experiments I have made this last Year. I beseech your Grace to communicate it to the *Royal Society*, and in particular to Mr. Gray, who works on this Subject with so much Application and Success, and to whom I acknowledge my self indebted for the Discoveries I have made, as well as for those I may possibly make hereafter; since 'tis from his Writings
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that I took the Resolution of applying my self to this kind of Experiments.

I have the Honour to be with the most sincere, and most respectful Attachment,

My LORD,

Your GRACE's

Most Humble and most

Obedient Servant,

D U F A Y.

F I N I S.